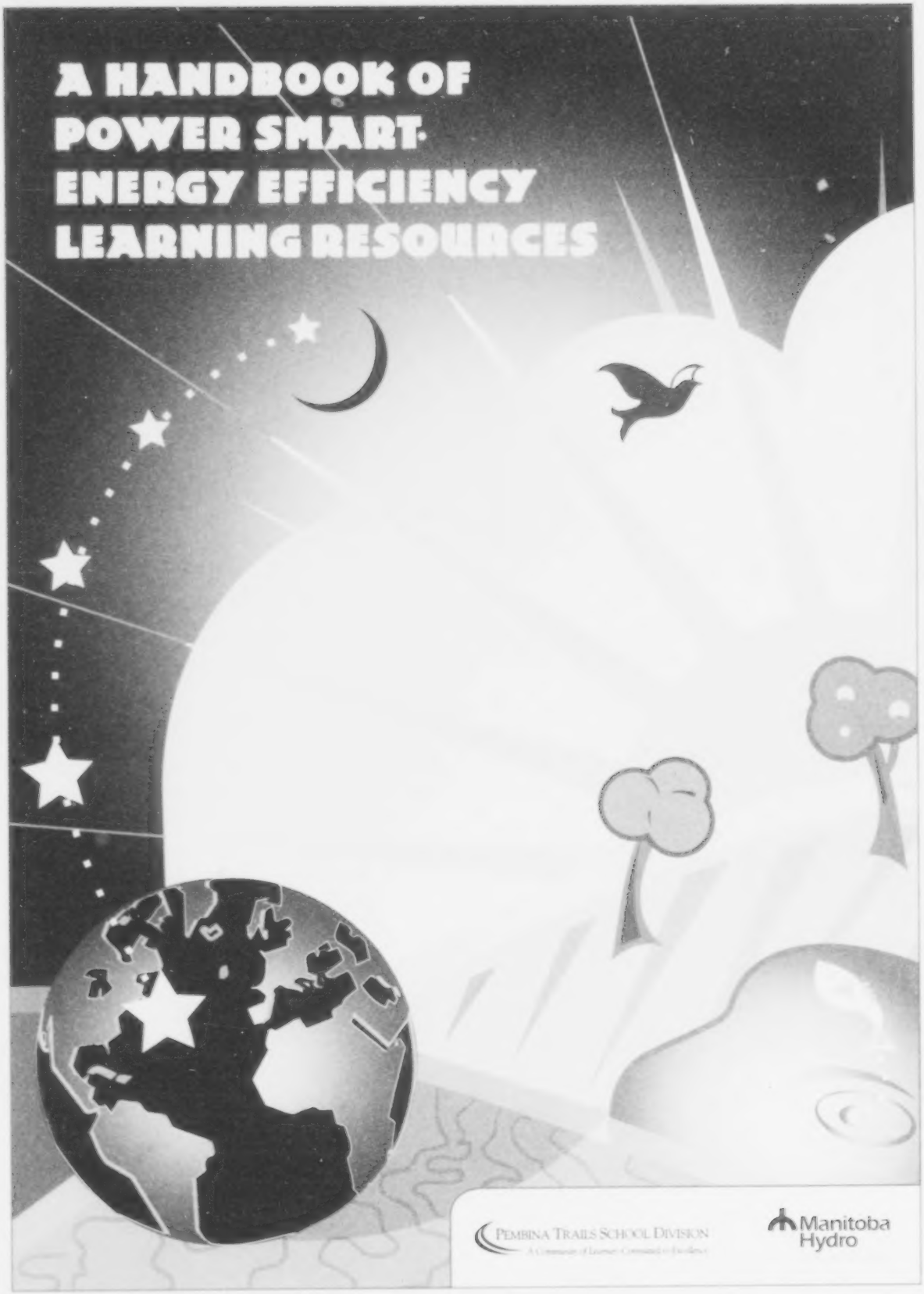
A HANDBOOK OF POWER SMART ENERGY EFFICIENCY LEARNING RESOURCES



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CONTENTS

Overview of the Handbook 5

- Goal of the Handbook 5
- Organization of the Handbook 5

Teacher Resource Materials

- **Energy** **9-16**
  - **i.** What is energy? 9
  - **ii.** What is non-renewable energy? 9
  - **iii.** What is renewable energy? 9
  - **iv.** Why bother with energy efficiency? 11
  - **v.** Energy efficiency vs. energy conservation 12
  - **vi.** Energy use in our homes 12
    - Too plugged in? 12
    - Coming clean 13
    - Keeping your cool 13
    - Is your home leaking energy dollars? 14
  - **vii.** Energy quick tips 14
  - **viii.** 9 Things you can do to stop wasting energy 16
- **Electricity** **19-22**
  - **i.** Electrical energy costs for appliances 19
  - **ii.** Enlightening comparisons 20
  - **iii.** Lighting tips 20
    - Indoor lighting 20
    - Outdoor lighting 21
  - **iv.** Light up holidays affordably, safely 21
  - **v.** Tips for lowering your oven/range energy usage 22
- **Water Efficiency** **25-29**
  - **i.** The inside story 25
  - **ii.** Water use 25
  - **iii.** Water efficiency 27
    - Household water use 27
    - Using water wisely 27
  - **iv.** What can you do to increase water efficiency at home? 28
  - **v.** Water... some other thoughts 29
- **Climate Change** **33-37**
  - **i.** Greenhouse gas 33
  - **ii.** The greenhouse effect 34
  - **iii.** What's wrong with warmer temperatures? 34
  - **iv.** What can we do? 35
  - **v.** Are you doing your bit? 35
  - **vi.** 10 Ways to reduce greenhouse gas emissions 36
  - **vii.** Potential effects of climate change in Canada 37
- **The Three R's** **41**
  - **i.** Reduce, reuse, recycle, and... 41

Student Learning Activities **45-59**

i. Energy in our homes 46
ii. Power Smart strategies at home – doing your share 47
iii. Increase your energy efficiency 49
iv. Home energy audit 50
v. Home appliances – electrical energy calculations 51
vi. Calculating operating costs of exit signs 53
vii. Reading your electrical meter and determining daily usage and costs 54
viii. Domestic water usage 55
ix. Water efficiency – what difference does age make? 56
x. Household water consumption questionnaire 57
xi. Greenhouse gas emissions & climate change 58
xii. The Three R's 59

Vocabulary Builders **63-67**

Matching and Power Smart Cryptogram 63
Energy Knowledge Crossword 64
Word Find 65
Power Smart Scrambled Columns and Power Smart Scrambled Words 66
Word Fill 67

Answer Key for Vocabulary Builders **71-74**

Matching and Power Smart Cryptogram 71
Energy Knowledge Crossword 72
Word Find 72
Power Smart Scrambled Columns and Power Smart Scrambled Words 73
Word Fill 74

Glossary **75**

Online Resources **76**

OVERVIEW OF THE HANDBOOK

This collection of teacher resource materials and student learning activities has been developed by Manitoba Hydro and Pembina Trails School Division as a resource to increase community awareness about energy efficiency, resource consumption and climate change through the Interdisciplinary Middle Years Multimedia (IMYM) model.

These materials were prepared through a cooperative partnership between Manitoba Hydro and the Pembina Trails School Division and formed part of the "Power Smart* Energy Manager" (PSEM) project during the period 2001-2005.

The goals of the PSEM project were to:

- Increase staff and student awareness about energy efficiency, resource consumption and climate change
- Increase energy and resource efficiencies in all divisional facilities through "no/low cost" changes in occupant behaviours and/or physical plant operating procedures
- To identify potential retrofit opportunities in mechanical and electrical systems that could be implemented to increase energy efficiency in all divisional facilities.

Goal of the Handbook

It is anticipated that these support materials will be of value to both students and educators in achieving the learning outcomes of the IMYM model and in understanding climate change and efficient usage of our energy and natural resources. There has been no attempt to include learning activities regarding electrical safety as resources on this topic are available through Manitoba Hydro under separate cover. More information on those publications can be found at www.hydro.mb.ca

These learning resources have been developed to increase awareness of:

- the nature of energy
- various forms of renewable and non-renewable energy
- sources of energy
- historical trends in energy usage
- energy efficiency vs. energy conservation
- increasing efficient usage of energy resources in homes, schools, and the workplace
- water efficiency
- climate change – causes and consequences
- other non-renewable natural resources
- the "R" words – Reduce, Reuse, Recycle, Refuse, and...

Organization of the Handbook

This Handbook includes five sections of teacher resource material followed by student learning activities for each of the following themes: energy, electricity, water, climate change, and The 3 R's. Each theme has been identified by an icon that is displayed on both teacher resource materials and student learning activities. Vocabulary Builders, a glossary of terms, and a list of online resources are also provided. The following index provides a recommended sequence of activities that may facilitate study of these themes.

Theme	Order of Presentation	Identifying Icon
Energy	**1**	
Electricity	**2**	
Water	**3**	
Climate Change	**4**	
The Three R's	**5**	
Student Learning Activities	**6**	
Vocabulary Builders	**7**	
Answer Keys for Vocabulary Builders	**8**	

Manitoba Hydro and Pembina Trails School Division are pleased to provide these learning resources to Manitoba Education, Citizenship and Youth for use by educators across a variety of grade levels within the province of Manitoba. It is anticipated that these materials will assist educators and students to adopt "environmentally responsible behaviours" that will ensure ecological sustainability of our natural and energy resources well into the future. Permission to reproduce these materials for usage in classroom learning activities is granted.

2005

TEACHER RESOURCE MATERIALS

ENERGY

ENERGY

WHAT IS ENERGY?

It is sometimes hard to grasp the importance of energy in our everyday lives. Almost every day we drive to work, on cold winter nights we turn on a heater, we store food in a refrigerator, we enjoy the beautiful lights during the holiday season... and the list goes on. We know what we do with energy, but what is energy really?

Energy is the capacity to do work or to make things move.

Energy can come in various forms: sound, light, heat, and motion. An important thing about energy is that it can be transformed from an initial source into its many forms. For example, a flashlight can transform a chemical source of energy, the battery – into electricity and then into light energy. When energy is talked about as a "resource", we are usually speaking of energy being converted from one form to another.

Energy has become an important part of our everyday lives. It is behind everything from the electric power that your alarm clock uses to wake you up in the morning to the bus that drives you to school.

WHAT IS NON-RENEWABLE ENERGY?

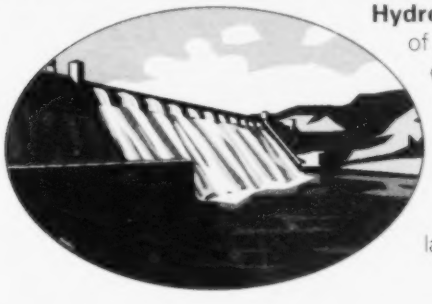
Non-renewable energy sources come out of the ground as liquids, gases, and solids. These fossil fuels have been formed from the buried remains of plants and animals that lived millions of years ago.

Today, crude **oil** (petroleum) is the only naturally liquid commercial fossil fuel. **Natural gas** and **propane** are normally gases, and **coal** is a solid. Coal, petroleum, natural gas, and propane are all considered fossil fuels.

These energy sources are considered non-renewable because they can not be replenished (made again) in a short period of time.

WHAT IS RENEWABLE ENERGY?

Renewable energy comes from sources that are continuously or easily renewed. Examples include solar power which comes from the sun, wind power, geothermal power, and hydroelectric power. We are fortunate here in Manitoba because we are able to use hydroelectric generation to provide nearly all of our electricity.



Hydro: Moving or falling water is an immense source of potential energy. Water is collected in dams, it can be used to create electricity that is known as hydroelectricity. The energy is later released as the force of falling water turns the wheels of machines called turbines and generators. These turbines use the moving water to create electricity. Because of the large number of rivers in Manitoba, we are a large producer of **hydroelectricity**.

The only supplier of electrical energy in our province is Manitoba Hydro, a crown corporation owned by all Manitobans. Over 95% of the electricity generated in the province comes from clean, renewable water power.

Solar: Plants are able to create food from the light of the sun. This process is called photosynthesis. The word "photo" means light and the word "synthesis" means to change. We can also use energy from the sun to make electricity. Photovoltaic panels made from silicon are able to convert sunlight into electricity.

Wind: Wind is one of the oldest forms of power generation. When winds blow against the blades of a windmill, the movement of the rotating windmill blades can pump water or produce electricity. Though not practical in all locations, wind generators are a good idea in those areas where they can be used because wind, like water, is a renewable resource.

Geothermal Energy: The temperature of the ground is fairly constant below the frost line. The ground is warmer in the middle of winter and cooler in the middle of summer than the outside air. An earth energy system can be used for both heating and cooling, eliminating the need for separate furnace and air-conditioning systems. This kind of system can also heat water at no additional cost. An earth energy system uses a series of buried pipes to transfer the heat from the ground into a building during the winter, converting it into warm air and distributing it through ducts. In summer, the system is reversed to transfer heat out of the building, where it uses the cooler ground as a heat sink.

QUICK FACTS ABOUT GEOTHERMAL HEATING SYSTEMS

- Ground-source heat pumps can reduce greenhouse gas emission by 66% or more compared with conventional heating and cooling systems that use fossil fuels.
- Earth energy systems use up to 75% less electricity than conventional heating or cooling systems
- Maintenance costs for this type of technology can be cut in half and operating costs reduced by one-quarter of that of a conventional system.

DID YOU KNOW

Canadians use more energy per person than any other people on Earth - yet we also have a deep appreciation for nature. Unfortunately, our energy practices often harm the environment.

This could all be avoided. If Canadians used more efficient buildings, cars, and appliances that use renewable energy, these negative effects could be dramatically reduced, and we would greatly reduce our energy consumption.

WHY ALL THIS TALK ABOUT SAVING ENERGY?

We use more energy each year than we used the previous year. In fact, during the 20th century, the amount of energy our Nation uses has doubled about every 20 years. We used two times the energy in 1955 as in 1935 and nearly twice as much in 1980 as in 1960. The rates of increase in our energy consumption have slowed somewhat, but we continue to use more and more energy.

Canada has become extremely dependent on using very large amounts of energy. Our nation is a huge energy user.

Unfortunately, energy hunger can have environmental consequences such as acid rain, air pollution, and climate change.

Around the world, this growing need for energy is creating environmental problems such as oil spills, and a constant search for more oil reserves. Dependence on oil supplies has even created military and political tensions between countries.

How we use energy affects the quality of our lives and the environment. So, it is essentialfor us to understand how energy use affects our lives from an individual and global perspective.

WHY BOTHER WITH ENERGY EFFICIENCY?

Life can be so overwhelming with all the "shoulds" and "need to" things we're supposed to do like eating the right foods, balancing school and home, etc. Sometimes it just seems too much! So why bother with one more thing?

Using energy efficiently is really the only way to:

- Reduce your home utility bills so you have extra money to spend on other things.
- Increase your comfort.
- Reduce environmental pollution and make our energy resources last longer.

And... it's easy! When you incorporate energy efficiency behaviours in your every day life and choose energy efficient products for your home, you can relax while they continue producing these benefits for you day after day, year after year.

Thinking in terms of saving energy is one of the ways of adopting a Power Smart attitude. You will find below a number of simple and convenient ways to be Power Smart that would not drastically change your normal daily routine.

- Change the lamps of interior fixtures that operate for more than four hours daily to compact fluorescent bulbs.
- Use warm or cool water instead of hot water for laundry. To further save water, wash only with a full load.
- Install timers or motion sensors on outdoor lights so that they will automatically turn on when someone enters the yard.
- Let the sun light your home by opening curtains or blinds.
- Install low volume shower heads and water saving retrofits to toilets.
- Install a programmable thermostat on your heating system that can be set to reflect your daily routines – you do not need to wake up to a chilly house in the winter, nor do you need to have the temperature at 22°C during the day when no one is at home.

ENERGY EFFICIENCY VS. ENERGY CONSERVATION

"Freezing in the dark" might be the phrase that best describes **energy conservation**. In the past, we have focused on saving energy by conserving energy – regardless of the comfort conditions that may have resulted. Energy conservation meant huddling under a dozen blankets during a cold Manitoba winter to save energy.

Energy efficiency is a far cry from old energy conservation images of the past. Energy efficiency is not just turning down the thermostat and sacrificing comfort. Energy efficiency means getting the most from every energy unit by practicing responsible behaviours in our daily lives and using state-of-the-art technologies to meet our needs for affordable and comfortable homes, profitable businesses and convenient transportation. It is the most immediate and cost effective way to reduce energy use and pollution.

If your house was energy efficient, you could lower your thermostat and be comfortable day and night, without drafts, cold spots, or guilt while doing your share for your family, your finances, and the environment.

An example of energy efficiency:

You replaced just four 100-watt incandescent bulbs that burn eight or more hours a day in you home with four 23-watt fluorescent bulbs. You'll get as much light and save at least 2,700 kilowatt-hours of electricity and about $135.00 over three years. If every household in Manitoba did the same, imagine how much energy could be saved in one year!

DID YOU KNOW

Fluorescent light bulbs use only a quarter of the energy that incandescent light bulbs use. They cost more to purchase, but cost less to operate and last about ten times longer. For every incandescent light bulb that is replaced by a compact fluorescent light bulb, about a ton of carbon dioxide is kept out of the air! Just think what the average household could contribute to the environment. Now that's being Power Smart!

ENERGY USE IN OUR HOMES

Too "Plugged In"?

In the past three decades, economic growth in our consumer-oriented society, the growth of new technologies, and the changing workforce with more people working from home, have all dramatically increased the number of products that require power in the average home. Some of today's homes sport multiple computers, printers, faxes, TVs, VCRs, CD players, and hair dryers.

Did you know that computer equipment is the fastest growing electric load in the world? In fact, there are forecasts that energy use by computers could double by the year 2010. Unfortunately, much of the energy for computers is wasted because they are often left on while not in use.

Furthermore, idle appliances – TVs, VCRs, cable boxes, CD players, cassette disks, cordless phones, burglar alarms, and microwaves – continue to consume energy when switched off. This energy keeps display clocks lit and memory chips and remote controls working. It is

estimated that these energy "leaks" account for 5% of total domestic energy consumption, and results in millions of tons of carbon needlessly spewed into the atmosphere.

It is also estimated that idle TVs, VCRs, and video games alone cost the average Canadian household more than $30.00 per year. There is hope for the future however, as new technology in TVs and VCRs will reduce this wasted energy by up to 50%.

Appliances such as older refrigerators and freezers can be major energy consuming devices. In the past 10 years happily, technological improvements have improved the efficiency of these appliances. It is estimated that the life span of refrigerators and freezers is approximately 20 years and the cost of replacing old, out-dated appliances with more efficient models can be recovered within seven years!

Look for the Energuide label on all new appliances to compare ratings!!

Be Power Smart "Buy Energy Star Products".

Consumers should also look for products that carry the Energy Star symbol. This international symbol is recognized around the world as a sign of ultimate energy efficiency. Energy Star products include: washing machines, refrigerators, furnaces, computers and lights. Products labeled with the Energy Star symbol save energy, save money and protect our environment. These products also meet or exceed strict energy-consuming specifications to qualify. It is estimated that products displaying the Energy Star symbol can help reduce energy and operating costs by 30-50%.

Coming Clean

From water glasses to cars, there's no shortage of washing to do around the home, all of which takes energy. Just making hot water uses about 14% of your home energy budget.

Many new innovations save energy in the cleaning department. One of the simplest and least expensive is a low-flow showerhead – a familiar technology that has improved from earlier versions. It can cut your shower water use in half while maintaining the same pressure as before. You might also want to think about doing more cold and warm water washes – or purchase a more energy and water efficient front loading clothes washer.

DID YOU KNOW

Each year, Canadians spend more money to power home audio and DVD products when turned off than when these appliances are actually in use!

Keeping Your C-o-o-o-l!!

Your thermostat controls the heating and cooling system that consumes more than half of the energy in your home – the biggest chunk of your family's energy budget. How much of that energy is used to keep your house comfortable when no one is home or everyone is asleep? Probably a lot, if you don't adjust the thermostat when you leave the house or go to bed.

Introducing the programmable thermostat!! It automatically coordinates the temperature of your home with your daily patterns – so you don't have to awake to a chilly bedroom in winter or come home to a stuffy house in the summer. Once you make the settings, you don't have to adjust the thermostat again.

POWER SMART TIPS

- When adding a programmable thermostat or replacing a furnace, air conditioner, or heat pump, look for the EnergyGuide label. You can use the information on the EnergyGuide label to compare an energy model in a category, its capacity, and estimated yearly energy cost.
- When adjusting the thermostat by hand, remember that the house will not warm up or cool down any faster if you crank up the thermostat past desired temperature. Besides, it is easy to forget to turn it back down, which will waste energy dollars.
- Clean or replace furnace and air conditioner filters once a month during heating/cooling season.

DID YOU KNOW

- Rule of thumb for thermostat savings: For each degree you lower your thermostat in winter, you can save about 3% on your heating bill.
- New energy efficient furnaces or air conditioning systems, when properly sized and installed, may save consumers 30-40% on heating and cooling bills.

Is Your Home Leaking Energy Dollars?

Perhaps your home wasn't built using today's high-quality, energy-efficient products or techniques. Are your heating and cooling bills higher than you would like? Where might energy be flowing from your home?

It might be going out the window – literally. The average home has enough leaks around its windows and doors to equal a one square meter hole in the wall!! Check your home's first line of defense against the elements – the roofs, walls, floors, windows, and doors. It pays to deal with air leaks first to get the maximum savings from your heating and cooling systems and other energy-efficient measures.

DID YOU KNOW

- Double-pane windows with low-e coating can reduce heating bills by 34% in our climate as compared to uncoated, single-pane windows. During the cooling season, low-e windows can cut cooling costs by 38%.

ENERGY QUICK TIPS

- Change the air filter in your furnace each month. Furnaces use more energy when the filter is full of dust.
- Use compact fluorescent bulbs wherever possible. It takes about one-fourth the energy that an incandescent lamp uses with the same light quality and lasts 10 times as long.

POWER SMART TIPS

- Appropriate insulation for our Manitoba climate (based on R-ratings) can increase your comfort and reduce your heating and cooling costs up to 30%. Start with attic insulation, followed by exterior and basement walls, floors, and crawl spaces.
- If you're shopping for new windows, glass doors, or skylights, look for the Energy Guide label. Today's high-efficiency windows are 40% more energy-efficient than standard ones and can significantly improve heating and cooling energy savings. Special low-e (low emissivity) coatings greatly reduce the amount of heat that flows through glass so there isn't as much heat lost in winter and gained in summer.
- Find and plug those leaks. Just wet you fingertips and run them around the door or window frame to feel a draft – or hold up a tissue and see if it waves. Seal leaks between moving parts (between door and its frame) with weather stripping. Fill leaks between non-moving parts (between the window frame and wall) with caulking.
- Install storm windows or double-paneled windows if you have single-pane windows. If you have older or leaky windows that you can't replace, consider temporary fixes, such as plastic films kits that create the effect of an interior storm window, or low-e retrofit film.

- Low-flow shower heads reduce water use by 50% or more – a standard shower head uses about 20 to 30 litres of water per minute.
- Keep your central air conditioning systems well-tuned. A well-tuned air conditioning system operates more efficiently, using less energy.
- Install a ceiling fan. Ceiling fans use about 98% less energy than most central air conditioners and yet create a cooling effect.
- Put a timer on your room air conditioner, or use a programmable thermostat on your central air conditioner/ furnace.
- Caulking and weather-stripping your home could result in energy savings of 10% or more.
- Use caulk or foam insulation to seal holes where conduits and pipes enter the attic and along partition walls, eaves, and knee walls.
- Insulate hot water pipes and heating ducts.
- Use your drapes. Open them on sunny winter days to let in warm sunlight; close them on winter nights to keep the heat in.
- Keeping car tires inflated to their rated pressure can improve your mileage up to 5% and extend the life of your tires.
- Have your car tuned as needed. A poorly tuned car could use as much as 3 to 9% more gas than a well-tuned one.

9 THINGS YOU CAN DO TO STOP WASTING ENERGY

1. Turn off the lights when you leave the room.
2. Shut down the computer at night and on weekends. Turn off the monitor when you leave the workstation.
3. Recycle used paper. It takes 10 times the energy to produce a new piece of paper than it does to make a copy on the second side.
4. Don't leave the television on if you're not watching it.
5. Make sure the VCR is turned off after you've finished watching a video.
6. Try to decide what you want from the refrigerator before you open the door because keeping the door open for a long time wastes energy.
7. Shut down computer games when you've finished with them.
8. Unplug appliances such as toaster oven and televisions when you go on vacation.
9. Keep your windows closed in the house if you're using the air conditioner in the summer or the furnace in the winter.

DID YOU KNOW

- Recycling two aluminum cans saves the same amount of energy as it takes to power a PC for one work day.
- Recycling paper can cut pollution by 50%, water use by 60%, and energy consumption by 70%.

TEACHER RESOURCE MATERIALS

ELECTRICITY

ELECTRICITY

ELECTRICAL ENERGY COSTS FOR APPLIANCES

We are surrounded by appliances. While these appliances may make our lives easier and more comfortable, they are also significant energy users.

When we use 1000 watts of energy for an hour, we consume what is called a kilowatt-hour (kWh). When paying for energy, we pay by the kilowatt-hour (kWh).

In Manitoba, the average residential cost per kilowatt hour is $0.05.

Look on the chart below to observe your household appliance consumption and see how much their use costs you. This information will vary depending on your use and the size of your family.

	Average kWh Annually	Average kWh Monthly	Annual Cost $0.05/kWh
Kitchen Appliances			
Range with self-cleaning oven	749	62	$39.55
Range with oven (baking)	226	19	$12.43
Dishwasher (with a dry cycle)	371	31	$20.41
Refrigerator / freezer (defrost/ice service)	1307	109	$71.89
Microwave oven	134	11	$7.37
Entertainment Appliances			
Colour TV (27")	335	28	$18.43
VCR	27	2	$1.49
Stereo	175	15	$9.63
Comfort Appliances			
Heat pump	6480	540	$356.40
Air conditioner, central	5100	Seasonal	$280.00
Continuous-use furnace fan	1836	153	$100.98

These are only a few of the many appliances that you may find around your home.

ENLIGHTENING COMPARISONS

Here's a simple comparison for two types of bulbs giving off the same amount of light and used for four hours per day for three years (4,380 hours). You'll replace the incandescent bulbs six times during this period, while the compact fluorescent will still have another 3.8 years of life left.

Incandescent vs. Compact Fluorescent Bulb

Bulb Type	100W Incandescent	23W Compact Fluorescent
Purchase Price	$0.75	$5.00 – $8.00
Life of the Bulb	750 hours	10,000 hours
Number of Hours Use per Day	4 hours	4 hours
Number of Bulbs Needed	about 6 over 3 years	1 over 6.8 years
Total Cost of Bulbs	$4.50 for three years	$4.85 for three years
Lumens	1,690	1,500
Total Cost of Electricity ($0.05 /kilowatt-hour)	$21.90	$5.04
Your Total Cost over 3 years	$26.40	$9.89

Total Savings over three years with the Compact Fluorescent: $16.52

POWER SMART TIPS

- Let "Mother Nature" light your home. Sunlight is brighter than a multitude of light bulbs, and it's free.
- Don't like coming home to a dark house? Instead of leaving lights on, put timers on a few of the lights in your home, or install motion detectors on exterior flood lights to improve your home security. After you get inside, the sensor will "remember" to turn the lights off.

LIGHTING TIPS

Indoor Lighting

- Turn off the light in any room you're not using, or consider installing timers, photo cells, or occupancy sensors to reduce the amount of time your lights are on.
- Use task lighting; instead of brightly lighting an entire room, focus the light where you need it. For example, use fluorescent under-cabinet lighting for kitchen sinks and counter tops under cabinets.
- Consider three-way lamps; they make it easier to keep lighting levels low when brighter light is not necessary.
- Use fluorescent fixtures and electronic ballasts for your workroom, garage, and other areas in your home.

Outdoor Lighting

- Use outdoor lights with a photocell, timer, or a motion sensor unit so they will turn off during the day.
- Exterior lighting is one of the best places to use CFLs because of their long life. If you live in a cold climate, be sure to buy a cold-weather CFL lamp.

DID YOU KNOW

- Compact Fluorescent Lamps (CFLs) provide the same lighting as incandescent bulbs at 1/4 of the energy consumption.
- Take advantage of daylight by using light-colored loose-weave curtains on your windows to allow daylight to penetrate the room while preserving privacy. Also, decorate with lighter colors that reflect daylight.

LIGHT UP HOLIDAYS AFFORDABLY, SAFELY

- **Operate your decorative lights for no more than six evening hours a day.** This keeps energy use and costs under control. If you leave your lights on 24 hours per day, you will spend four times the money on electricity.
- **Turn Christmas lights off during the day or when you are away.** Photo-cell controllers or timers are a simple way to do this. For safety's sake: Always turn off your lights before going to bed or leaving home.
- **"Icicle" lights** have more lights per linear foot than regular light strands and use more energy.
- **Here's how to come out ahead:** For each compact fluorescent (CFL) bulb you substitute for an incandescent bulb in your home, you can afford to light a string of 100 mini-lights and still save energy, money, and the environment. During the next year, the CFL will save five times the energy of the light string.
- **Protect little fingers:** Make sure there's a bulb in each socket. If a bulb is burned out, leave it in until you have a replacement.
- **Don't overload your electric circuits.** Check your fuse or circuit breaker panel to see how much lighting your home can handle, and stay well within the limits.
- **For outdoor lights, use Ground Fault Circuit Interrupters (GFCIs)** on each circuit to automatically shut off the current when a leak is detected. Cover outdoor plugs and connector joints with a water-resistant layer of plastic wrap and electrical tape.
- **Make sure your lights have a safety rating** and use only as intended. Keep extension cords and light sets away from a metal tree stand, and keep your natural tree watered to prevent bulbs from igniting dry branches.
- **Unplug the lights after the holidays!** No need to light up the night until spring!
- **LED (Light Emitting Diode) Holiday lights** last longer and have lower operating costs than traditional decorative lights. Some benefits of LED lights are:
  - **Cost effective:** although LED lights cost more to buy, they pay for themselves in two to five years through reduced energy use and bulb replacement.
  - **Energy efficient:** LED lights use up to 97% less energy than standard incandescent

bulbs.

- **Save time:** LED lights can last up to 100 000 hours.
- **Safety:** LED lights are more durable, with no filament or glass bulbs to break. They also produce very little heat, reducing the risk of fire.
- **Warranty:** LED strings can be guaranteed up to five years.

TIPS FOR LOWERING YOUR OVEN/RANGE ENERGY USAGE

- Preheat ovens only when necessary. With conventional ovens, keep the preheating time to a minimum. Unless you're baking breads or pastries, you may not need to preheat the oven at all.
- Food cooks more quickly and efficiently in ovens when air can circulate freely. Don't lay foils on racks. If possible, stagger pans on upper and lower racks to improve air flow.
- Use glass or ceramic pans in ovens. You can turn down the oven temperature by 5°C (25°F) and cook foods just as quickly.
- Do not open the oven door often to preview the food. Each time you open the door, the oven temperature drops by 5°C (25°F). Watch the clock or use a timer instead.
- Full-size ovens are not very efficient for cooking small to medium-sized meals; it generally pays to use toaster ovens or microwave ovens.
- Check to be sure the oven door gasket is tight. Adjust or replace gasket as required.
- If you have a self-cleaning oven, consider using the self-cleaning feature immediately after regular baking when the oven is still hot. Less energy will be required to reach the cleaning temperature. Try not to use the self-cleaning feature too often.
- Keep range-top burners and reflectors clean; they will reflect the heat better and save energy.
- Match the size of the pan to the heating element; more heat will get to the pan and less will be lost to the surrounding air. A 15 cm pan on a 20 cm burner will waste more than 40% of the energy.
- On electric stove tops, use only flat-bottomed pans that make full contact with the element. A warped or rounded pan will waste much of the heat.
- When cooking with a gas range-top burner, use moderate flame settings to conserve gas. Also, make sure the pilot light is burning efficiently, with a blue flame. A yellowish flame indicates an adjustment is needed because the gas is burning inefficiently.
- Whenever possible, use a pressure cooker. By cooking food at a higher temperature while under pressure, cooking time will be reduced dramatically and energy use reduced by 50-75%.

TEACHER RESOURCE MATERIALS

WATER EFFICIENCY

WATER EFFICIENCY

THE INSIDE STORY

DID YOU KNOW

The human body is 70% water. Every system in our body uses water:

- Water makes up 83% of our blood.
- Water transports body wastes.
- Water lubricates our body joints.
- Water keeps our body temperature stable.
- Water is a large part of cells which make up all living things.

As you can see, water is vital to our survival! Human beings can live several weeks without food, but only a few days without water. Less than 3% of all water on Earth is fresh water, and 9% of the world's fresh water is in Canada. We use this water not only for drinking, but for transportation, heating and cooling, industry, and other purposes.

We are very fortunate in Manitoba to have large supplies of water. Yet, other regions of North America are not as fortunate.

However, the cost of clean, fresh water is steadily rising, along with problems associated with large quantities of pollutants being dumped into rivers and streams. By reducing the consumption of water in our homes, we conserve nature's valuable supply of fresh water and save money as well.

TIP:
When hot water usage is reduced, savings are multiplied because energy is conserved as well.

WATER USE

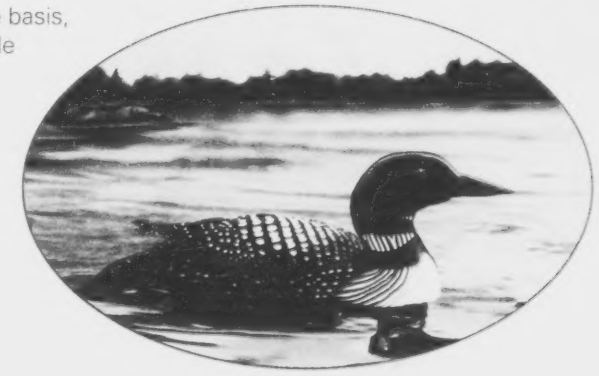
Manitoba appears to have an abundance of water and it plays an important role in our daily lives. However, much of the water is located in more isolated areas where there are few people. Water uses include drinking, home use, recreation, irrigation, industrial operations, aquatic life, and wildlife habitat.

Rivers power turbines for the production of almost all of our electrical energy and assimilate much of our wastes. Lakes and rivers support a wide range of recreational activities – from swimming and water-skiing to fishing and boating. Ground-water aquifers provide much of rural Manitoba with water for domestic consumption, irrigation, and industrial processes.

Many Economic Uses

Surface water is a vital element for a wide variety of economic uses. Almost 80% of Manitobans rely on surface supplies for their drinking water. Most of Manitoba's electrical energy is generated from surface waters and most of our industrial water needs are also provided by lakes and rivers. Dugouts, ponds, and streams are used extensively by Manitoba farmers for watering livestock, irrigating crops, and drinking water. Though much less

significantly today on a province-wide basis, surface water is still an essential mode of transportation of goods and raw materials for many communities along the northeast shore of Lake Winnipeg. In addition to providing an essential raw material for our economic needs, surface water across the province is used for assimilation of our domestic, municipal, and industrial wastes.



DID YOU KNOW

- Three of Canada's 15 largest lakes are found in Manitoba - Lake Winnipeg, Lake Manitoba, and Lake Winnipegosis.
- West Hawk Lake is the deepest lake in Manitoba.
- About 12,000 years ago, glacial Lake Agassiz covered 80% of Manitoba.
- Manitoba is the only province in Canada where all water in the rivers eventually flows north.
- More than 70% of the flow in our streams originates outside of Manitoba.
- Lake Winnipeg - the largest lake in Manitoba and the twelfth largest in the world - covers 24,389 km^2.
- Approximately 16% of the surface of Manitoba is covered in water.
- The Nelson, Churchill, Seal, and Hayes rivers carry more than 99% of the water flowing from Manitoba into Hudson Bay. The Nelson River alone carries over 60% of this flow.
- Climate change is expected to influence Manitoba's water resources. Warmer temperatures are likely to increase water temperatures and reduce the length of ice-covered conditions.
- Like most of the rivers in southern Manitoba, the Red River normally carries 75% of the annual runoff between April and June.
- In the Red River Valley flood of 1950, water levels rose 15 m, and the flow rates were 100 times greater than under drought conditions.

DID YOU KNOW

- Only 2.7% of the earth's water is freshwater - 2.2% is locked up in glaciers and polar ice caps, leaving about 0.5% distributed as groundwater, soil moisture, atmospheric water vapour, lakes, and rivers.
- The average annual precipitation in the province ranges from 400 mm in northern Manitoba to 600 mm in the southeastern corner.
- Two-thirds of Manitoba's precipitation falls between May and October.
- Manitoba's average snowfall ranges from 1200 mm in the south to 1700 mm in the north.
- Each year, an average of 300-350 mm of water is evaporated in the north while 450-500 mm evaporates in the warmer half of the province.
- Manitoba's large lakes have a moderating effect on climate - they act as heat sinks making the fall and early winter milder and summer cooler.
- Winter snowfall serves as water in storage. When the winter snow melts in the spring, Manitoba's rivers and streams carry large amounts of water and many serve as an important spawning ground for fish.
- Two-thirds of the human body is composed of water. In fact, water is so important to our bodies that we can only survive for a few days without it, but over 30 days without food.
- Heavy rain results in more runoff while light steady rain generally soaks into the soil.

WATER EFFICIENCY

Household Water Use

Water efficiency should be practiced at home and at the cottage. The cost of constructing and operating drinking water and sewage treatment plants is increasing. The demand for water is rising, while pollution, lower groundwater tables, and other factors are shrinking the supply of usable water in some areas of southern Manitoba.

Every day, the average Manitoban uses about 350 litres of water – two and a half times the amount used per person in Europe. In households, about 40% of the water is used to flush toilets, 35% is used for baths and showers, 20% is used for laundry and dishes, and 5% is used for drinking and cooking. During the summer, lawn watering and car washing can increase water use by 50% or more.

Using Water Wisely

Water is wasted in many ways and can be used more wisely by reducing, repairing, and retrofitting. You can reduce your water use by making a conscious effort to not waste water whenever possible. Repairing leaks in taps, toilet tanks, and pipes can save water and money – a drip at the rate of one per second wastes 10,000 litres of water per year. Retrofit older and inefficient toilets, showerheads, and faucets with water saving equipment like early closure devices or low-flow faucet aerators and showerheads. If you are replacing fixtures or appliances, consider installing low-flush toilets (six litres per flush or less) and low water-use dishwashers and washing machines.

WHAT CAN YOU DO TO INCREASE WATER EFFICIENCY AT HOME?

In General

- Repair tap, faucet, pipe, and hose leaks promptly.
- Replace conventional toilets with low volume-models.
- Turn taps off tightly so they do not drip.
- Use low-flow faucet aerators.

In the Bathroom

- Check for toilet tank leaks and repair them promptly.
- Toilets use the largest proportion of household water – about 40%. An early closure device can reduce water use.
- Low-flush toilets are available and are practical for home and cottage use.
- Short showers use less water than baths; use a low-flow showerhead.
- For bathing fill only half the tub with water.
- Use a partially filled sink rather than running water continuously while washing your hands or shaving.

In the Kitchen

- Use the dishwasher only when full; use the cycle that requires the least water.
- Hand wash dishes in a partly filled sink. Instead of using running water to rinse the dishes, fill a separate sink or use the faucet spray attachment.
- Keep a container of drinking water in the refrigerator instead of running tap water until it is cold.

Laundry

- Only use the washing machine when full; use the cycle that requires the least water.
- Adjust the water level if smaller washes are necessary.
- If you have a septic system, limit the number of loads per day to avoid overloading your sewage system.

Outdoors

- Reduce lawn area by replacing with drought tolerant plants.
- Water your lawn only when it needs it. Lawns require only 2-3 cm of water (including rain water) per week. You can determine the amount used by collecting water in a pan placed under the sprinkler.
- To reduce water evaporation, water in early morning or late afternoon and avoid watering on windy days.
- Drip irrigation or soaker hoses are the best methods for conserving water while watering plants.
- A low-level sprinkler is the best type to use for watering the lawn; an oscillating sprinkler loses up to 50% of water to evaporation.
- Cut your grass to a height of 5-8 cm and leave the grass clippings on the lawn – this shades plant roots during hot weather, and will help retain moisture.
- Shrubs and young trees usually require watering only once a week or less depending on the variety.
- Transplanted or young garden plants should be watered more often with small quantities of water until they become well-established.
- Use organic mulch around plants and trees and incorporate compost into your garden soil to help retain moisture.
- Washing your car with running water can use up to 400 litres of water. Use a bucket, a sponge, and a trigger nozzle on the hose to reduce water consumption
- Instead of washing leaves, soil and debris off a driveway or sidewalk, use a rake or broom and compost the leaves.

WATER... SOME OTHER THOUGHTS

Keeping the Heat In

Heating water can be the second largest energy use in most homes. Efficient water heating systems produce hot water quickly and lower energy bills. Heat escaping from the walls of water tanks and pipes can significantly increase a hot water heating bill! By reducing the thermostat setting and properly insulating your hot water tank and pipes, you could see a 25% saving on your home water heating costs.

Fixing Leaks

Keeping faucets in good repair is key to home water conservation and it's easy! Household leaks can account for as much as 14% of all indoor water use.

The most common source of leaks is the toilet. Toilets that leak between flushes can waste as much as 200,000 litres per year – that's enough to fill a pool 8 meters wide x 8 meters long to a depth of 3 meters.

From Old to New

Replacing, or retrofitting, your water hardware with efficient water-saving devices can substantially decrease your water use and your water bill. Consider the following:

Conventional Device	Retrofit Device	You Can Save
Toilet		
Uses approximately 13-26L/flush	Early Closure Flapper 6L or less Flush Toilet	6L/flush 15L/flush
Showerheads		
Use approximately 18L/minute	Water Efficient Showerheads	7L/min
Kitchen/Bathroom Faucets		
Use approximately 15L/minute	Faucet Aerator	4L/min.

Add a couple of drops of food colouring to your toilet tank – but don't flush. If the food colouring has seeped into the bowl after 15 minutes, the flapper valve or overflow tube is leaking. New flapper valves can be purchased at a local hardware store and are easily replaced.

TEACHER RESOURCE MATERIALS

CLIMATE CHANGE

CLIMATE CHANGE

GREENHOUSE GAS

Gases in our atmosphere – water vapor, carbon dioxide, methane, and nitrous oxide – act like a greenhouse to keep the sun's heat in and help make our planet livable. Without this natural greenhouse effect, the average temperature on Earth would be -18°C – too cold to support life.

But too many greenhouse gases can be harmful. As we burn more and more fossil fuels to power our cars and trucks, keep our industries humming, and make homes more comfortable, we are increasing concentrations of greenhouse gases in our atmosphere.

In Canada, **carbon dioxide** (CO_2) is the gas creating the largest amount of emissions, responsible for 81% of Canada's total greenhouse gas emissions. Carbon dioxide is naturally released as we breathe and is good in regular amounts since plants need it to conduct photosynthesis. But as we cut down forests and increase the amounts of CO_2 in the atmosphere with the use of fossil fuels, cars, and burning wood, CO_2 levels are increasing to the point where it cannot all be used up. In turn, it is trapping the sun's rays and converting it to heat energy at increasingly higher rates.

Other Greenhouse Gases

Methane – Methane gas accounts for approximately 14% of Canada's greenhouse gas emissions. The main sources of methane emissions are from oil and gas production, animal digestion and manure, municipal landfills, and coal mining.

Nitrous Oxide – Nitrous oxide accounts for approximately 5% of Canada's greenhouse gas emissions. The primary sources of this gas are transportation and fertilizer use.

Hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride – These three gases account for the remaining 1% of Canada's greenhouse gases. Although emitted in small quantities, they continue to contribute to global warming potential and have long-lasting effects on the Earth's atmosphere.

Hydrofluorocarbons (HFCs) are compounds containing carbon, hydrogen and fluorine. HFCs are primarily being used as substitutes for CFCs and HCFCs, and sources of HFCs can be found in refrigeration and air conditioning, plastic foam blowing, aerosols, and fire fighting fluids.

Perfluorocarbons (PFCs) are compounds comprised of carbon and fluorine. The main source of PFCs is from the electronics industry, particularly semiconductor manufacturing, and as a by-product of aluminum smelting processes. PFCs have atmospheric lifetime of over 2300 years. Of the three gases, PFCs account for the largest percentage (0.7%) of greenhouse gas emissions.

Sulfur hexafluoride (SF_6) is primarily used as a dielectric in electrical transmission and distribution systems, specifically as an insulator for circuit breakers and switchgear. Another common use of this gas is as a cover gas in aluminum and magnesium production.

THE GREENHOUSE EFFECT

The greenhouse effect is what is responsible for keeping us warm on Earth. If you've ever been in a greenhouse or a closed car on a hot and sunny day, you know how well it works. The sun's rays enter a greenhouse or car through a window and some of the light rays are converted to heat and trapped inside.

The Earth acts like a greenhouse. A portion of the sun's rays that strike the earth bounce back towards space as heat rays. Some of these heat rays are trapped in the atmosphere by greenhouse gases such as carbon dioxide (CO_2), methane, and nitrous oxide, helping warm the planet.

Most greenhouse gases such as CO_2, methane, and nitrous oxide are normally present in the atmosphere because of natural processes. The Earth needs a certain amount of these gases in order to maintain balance. It is estimated that without CO_2 in the atmosphere, the average global temperature would be below freezing instead of a more comfortable 16°C. However, many human activities, such as burning large amounts of fossil fuels and cutting down forests, have drastically increased the level of greenhouse gases in the atmosphere. Also, humans have artificially created powerful greenhouse gases called CFCs. All these powerful greenhouse gases trap more heat, and as a result, scientists believe that the world will get warmer because of it.

Negative consequences of the Greenhouse Effect...

For many of us living in Canada, these predictions may sound like good news – after all, our winters would be milder. Unfortunately, it is not all good news. Even a small temperature rise of a few degrees might melt ice at both the North and South Poles. The melting ice would raise the ocean levels and flood some coastal cities. Consider that a temperature increase as small as 5% could potentially melt the Arctic ice cap completely.

Small changes in the average temperature have the potential to cause significant changes in the world's life sustaining ecosystems. What if the prairies, which presently produce an abundance of food, become too dry to produce crops? Ecosystems in the boreal forest could also be altered in ways that cause harm to other species. Global warming could cause unpredictable weather such as tornadoes, drought, floods, and hurricanes. It may also encourage insect outbreaks that would make it hard for some species to survive.

All the above are examples of what could happen if the Earth's temperature was to increase because of the greenhouse effect. The problem is that we do not really know what will happen. Maintaining our present course of action is simply a big gamble. Many people don't like the idea of experimenting with the Earth and the well-being of its inhabitants. You can do your part in reducing the artificial greenhouse effect by being **Power Smart** and using energy efficient technologies and avoiding the use of practices that would increase the amount of greenhouse gases in the atmosphere.

WHAT'S WRONG WITH WARMER TEMPERATURES?

To some Manitobans, warmer temperatures may seem appealing – especially in the middle of winter. But scientists in Canada and around the world have warned of the possible consequences, some of which we may already be experiencing:

- More **severe weather** events such as thunderstorms, heavy rains, hail, and tornadoes could take a heavy toll on human lives and property.
- Longer and more intense **heat waves** could make air pollution in larger urban areas worse. Air pollution has been linked to increased deaths and illness from asthma and other respiratory diseases.

- More **droughts** could harm crop yields, increase the risk of forest fire, affect the quantity and quality of our drinking water, as well as affect the use of lakes and rivers for transportation, recreation and fishing.
- While **warmer temperatures** are expected to cause an increase in global precipitation, scientists are uncertain how this might affect river flows and lake levels and to what extent this might impact industries such as hydroelectricity generation that depend on water supply. The impact of runoff for any particular region would depend on many factors including soil conditions and changes in precipitation and evaporation.
- **Rising sea levels** could increase flooding and erosion along Canada's coasts. Combined with violent storms, this could cause sea water to surge inland, damaging buildings, roads, and bridges.

WHAT CAN WE DO?

All Canadians produce greenhouse gas emissions, and reducing these emissions is a big part of the solution to the problem of climate change. Actions by individuals at home, at work, and on the road are an essential part of Canada's climate change response. The energy-using habits of individual Canadians account for about 28% of Canada's total greenhouse gas emissions-almost five tonnes per person every year!

The easiest way to be part of the solution is to use energy more efficiently. Small steps really do make a difference in reducing Canada's total energy consumption, especially when millions of Canadians coast to coast are taking those steps.

Using less energy by being Power Smart not only cuts greenhouse gas emissions, it reduces pollutants that cause smog and acid rain. And let's not forget one of the most important benefits of all: energy efficiency could also save you money!

DID YOU KNOW ?

The 20th century was the warmest globally in the past 1,000 years. In fact, the 1980's and 1990's were the warmest decades on record. A panel of international scientists has predicted that average global temperatures could rise by as much as 1.4°C to 5.8°C by the end of the 21st century. In Canada, average temperatures in some regions could rise by as much as 5°C to 10°C.

ARE YOU DOING YOUR BIT ??

Climate Change

All Canadians contribute to greenhouse gas emissions – every time we turn on the lights, drive the car to work or the store, start up the computer or do anything that uses energy. The actions of individual Canadians account for about 28% of Canada's total greenhouse gas emissions – that's almost 6 tonnes per person per year!!

If we're part of the problem, then we must be part of the solution – check out the following ways that you can reduce your energy consumption, save money and help create a healthier environment for Canada... every bit counts!

DID YOU KNOW

All the cracks & air leakage in the average home add up to a 14 cm^2 hole in your wall! Your heat - and your $$ are disappearing through that hole.

What can you do about it?

10 WAYS TO REDUCE GREENHOUSE GAS EMISSIONS

1. Turn off lights, appliances, televisions, computers and game toys when they are not in use. Many electronic appliances consume energy even when turned off, because they are in "stand-by" mode. Unplug these appliances when you are away for more than a week.
2. Seal all leaks around doors and windows and creaks where heat escapes from your home. You may save up to 20% on your heating bill.
3. Insulate when you renovate your home. A small, up-front cost can pay for itself in energy savings several times over in the life of the house.
4. When buying a new household appliance, air conditioner or vehicle, check the energy performance to help you select the most efficient model that meets your needs.
5. Avoid idling your vehicle unnecessarily – 10 seconds of idling uses more fuel than restarting the vehicle.
6. Use an automatic set-back thermostat for your home heating and cooling systems.
7. Leave your car at home – walk, cycle or take public transportation – one bus load of passengers takes 40 vehicles off the road, saving 70,000 litres of fuel, 175 tonnes of CO_2 emissions and 9 tonnes of pollutants each year.
8. Use energy efficient lighting products such as compact fluorescent lamps – they last 10 times longer and use 75% less energy!
9. Clean or replace your furnace filters regularly to ensure good airflow and heat distribution within your home.
10. Install low-flow shower heads and toilets and repair leaking faucets to reduce the needless use of water and energy required to transport the water to your home.

TIP:
Cars don't belong at school!!!
What can we do to encourage each other to walk or cycle to school?

DID YOU KNOW

Canadians, idling light-duty vehicles for five minutes every day, waste over 1.6 million litres of fuel and produce more than 4,500 tonnes of greenhouse gas emissions.

POTENTIAL EFFECTS OF CLIMATE CHANGE IN CANADA

Permafrost is melting in Canada's NORTH, putting transportation routes and buildings at risk. The Arctic sea ice cover is becoming thinner and summer ice cover has shrunk by some 15% during the past 50 years.

Shorter ice seasons mean less feeding time for polar bears and force them to stop hunting earlier, impairing cub survival. An increase in summer insects may threaten caribou and reindeer populations.

Sea levels on the northern coast of BRITISH COLUMBIA could rise up to 30 cm by 2040 - warmer ocean temperatures will send cold water fish further north in search of colder water.

Expect more severe weather-related events such as heat waves, floods and winter storms in QUEBEC. Water levels in the St. Lawrence River are projected to be about 1.25 m lower.

Overall crop yields on the PRAIRIES are expected to fall as drought conditions offset a longer growing season. Drier weather could also make crops vulnerable to pests and disease. Forest zones could shift North. Drier fire seasons may lead to more frequent forest fires.

The sea level in the ATLANTIC PROVINCES will increase as much as 70 cm - leading to more intense and more frequent storms causing flooding and coastal erosion.

SOUTHERN ONTARIO will see shorter winters and an increase in hot, humid days in summer. Great Lakes water levels will be lower and could affect hydro-electricity generation. There can be an increased number of forest fires throughout the province.

TEACHER RESOURCE MATERIALS

THE THREE R'S

THE THREE R'S

REDUCE, REUSE, RECYCLE, AND...

Reduce – Reduce is the first R because it is the most immediately achievable strategy and should be considered before all other actions. To reduce is to decrease all unnecessary waste in every way possible. What you save could be natural resource for an endangered species. Some ways to reduce include:

- Reduce unnecessary amounts of water you use; for example turn off the water while brushing your teeth.
- Cut down on packaging by buying food items in bulk.
- Buy products with the least amount of packaging.
- Try and avoid disposable products.

These steps do not take too much effort, but they make a large difference for the environment.

Reuse – Reusing a product is using a product more than once for its original purpose or for a new purpose rather than throwing it away. Some examples of reuse include:

- Buying and selling used products.
- Buying high quality, long lasting products.
- Repairing instead of replacing equipment.
- Reusing of plastic and cardboard items. (i.e. Lunch containers)

Recycle – Recycling is turning the raw materials of one product into a new product, such as recycling used paper into new paper. Some ways to support recycling include:

- Setting up a paper recycling program at your school.
- Buying products that are made from recycled materials.
- Begin composting.

The three R's: **reduce**, **reuse**, and **recycle** are very important elements for conservation. There are also other R words that expand ways to reduce garbage: think about *recovering, rethinking, responding, replacing, and refusing.*

STUDENT LEARNING ACTIVITIES

STUDENT LEARNING ACTIVITIES

CONTENTS

Icon	Topic	Page
	Energy In Our Homes	46
	Power Smart Strategies At Home – Doing Your Share	47-48
	Increase Your Energy Efficiency	49
	Home Energy Audit	50
	Home Appliances – Electrical Energy Calculations	51-52
	Calculating Operating Costs of Exit Signs	53
	Challenge Activity – Reading Your Electrical Meter and Determining Daily Usage and Costs	54
	Domestic Water Usage	55
	Water Efficiency – What Difference Does Age Make?	56-57
	Greenhouse Gas Emissions & Climate Change	58
	The Three R's	59

STUDENT LEARNING ACTIVITY

ENERGY IN OUR HOMES

Student Name: _____

1. Which best describes "energy efficiency":
   a. Turning off the lights when you leave the room?
   b. Using compact fluorescent bulbs to replace incandescent lamps?

   Why did you select this response?

   _____

   _____

   _____

   _____

   _____

2. What is one form of "non-renewable energy"?

   _____

   _____

   _____

   _____

   _____

3. What is one form of "renewable energy" that you want to learn more about?

   _____

   _____

   _____

   _____

   _____

4. List 2 examples of each form of energy found in your house:

	Sound Energy	Light Energy	Heat Energy
1.			
2.			

STUDENT LEARNING ACTIVITY

POWER SMART STRATEGIES AT HOME — DOING YOUR SHARE

Student Name: _____

There are many ways to improve your home's energy efficiency. The choices are yours:

1. You can invest in the latest energy-efficient technologies and products,
2. You can make basic home improvements, and/or practice energy-saving habits.

Check Yourself Out!

Here is a brief checklist to see how you are doing. Use it to assess how Power Smart you are and to set some goals for you and your family. You may need to interview someone in your home to help you with this activity.

POWER SMART	Already In Place	Household Goal	Date Achieved
Appliances & Home Equipment			
1. high-efficiency furnace/air conditioner or heat pump installed			
2. programmable thermostat installed			
3. double-pane windows with low-e coatings installed			
4. compact and other fluorescent light bulbs installed			
5. energy-efficient refrigerator purchased			
6. dishwasher that saves water and energy purchased			
7. clothes dryer with moisture sensor purchased			
8. clothes washer that saves water and energy purchased			
9. efficient home office equipment and electronics			
10. insulate attic, exterior walls, basement, and crawlspaces			
11. replace inefficient incandescent lamps with energy efficient lamps or compact fluorescent lamps			

STUDENT LEARNING ACTIVITY (CONT'D)

POWER SMART STRATEGIES AT HOME

POWER SMART	Already In Place	Household Goal	Date Achieved
Low Cost Home Improvements			
1. replace furnace and air conditioning filters monthly			
2. caulk between window/door frames and walls			
3. weather-strip windows and doors			
4. add storm windows or use plastic film kits to improve single-pane windows			
5. insulate hot water heater			
6. install motion sensors, dimmers, and timers for indoor and outdoor lighting			
7. plant trees to shelter your home from the elements			
8. install ceiling or other fans to cut down on air conditioning costs			

POWER SMART	Already In Place	Household Goal	Date Achieved
No Cost Energy Conscious Behaviours			
1. clean furnace and air conditioner filter			
2. turn off lights when you leave a room			
3. use sunlight for light or heat whenever practical			
4. match pot size to burner size and keep the lid on it			
5. set hot water heater no higher than 55°C (125°F)			
6. do laundry in cold or warm water when possible			
7. enable the hibernation or sleep feature on your computer			
8. turn off electronics when not in use			
9. close blinds or shades in summer			
10. do only full loads in dishwasher, clothes washers, and dryers			
11. keep your car tuned up and its tires properly inflated			

STUDENT LEARNING ACTIVITY

INCREASE YOUR ENERGY EFFICIENCY

Student Name: _____

In a group of three, take some time to think about instances when you and your families have increased energy efficiency in your homes. Think of opportunities that exist within your homes that would permit you to become even more energy efficient. Make a list of all the things you have done in your homes.

	The Energy Source Is...	What We Did To Increase Energy Efficiency
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

STUDENT LEARNING ACTIVITY

HOME ENERGY AUDIT

Student Name: _____

Go through each room in your house and look for all the energy using appliances you have. Record them all in the chart below – then fill the third column with what you can do to make them more energy efficient. Remember, even if something is not on, if it is still plugged in, it may use energy. If it's plugged in – it's powered up!

Location	Energy User	Energy Efficient Idea
Example:	❑ 2 lights	❑ use compact fluorescent bulb.
Living Room	❑ television	❑ turn off when not using.
	❑ VCR	❑ unplug when going away.
	❑ clock	❑ use rechargeable batteries.

STUDENT LEARNING ACTIVITY

HOME APPLIANCES — ELECTRICAL ENERGY CALCULATIONS

Student Name: _____

1. You can easily calculate an estimate of your monthly energy costs if you know the typical watt amount used by the appliances in your home. Below is a table of a variety of appliances that you may have in your home. Use this table to calculate an estimate of your monthly expenditures on electricity.

1	2	3	4	5	6
Type of Appliance	In Our Home We Have One	Typical Wattage (W)	Typical Hours of Use/Month	Monthly Kilowatt Hours (C3 x C4) 1000	Monthly Cost C5 x 0.05
Example: Car block heater	√	**617W**	10hr/day x 30 days = 300 hrs	$\frac{617 \times 300}{1000}$ = 155kWh	$10.18
Central Air Conditioner, 2 ton		**2500W**			
Air Conditioner, Rm 6000 BTU		**705W**			
Stove element		**1050W**			
Hair dryer		**1250W**			
Car block heater		**900W**			
Car warmer		**850W**			
Clothes dryer (standard)		**4850W**			
Clothes washer		**564W**			
Coffee maker		**985W**			
Computer (with monitor)		**130W**			
Deep fryer		**1495W**			
Dehumidifier		**381W**			

Dishwasher		**1238W**			
Electric blanket		**237W**			
Iron		**1073W**			
Fan (portable)		**104W**			
Compact freezer (manual defrost)		**280W**			
Fry pan/Skillet/ Wok		**1035W**			
Furnace fan (continuous)		**300W**			
Garbage disposer		**445W**			
Grill (sandwich)		**1125W**			
Toaster Oven		**1413W**			
Humidifier		**125W**			
Kettle		**1213W**			
Microwave (standard size)		**800W**			
Range (oven baking)		**2350W**			
Refrigerator (with ice service)		**780W**			
27" Colour Television		**255W**			
Toaster (2 slice)		**1080W**			
VCR		**60W**			
Lawnmower		**1200W**			
Vacuum cleaner (central)		**1055W**			
Water heater family of 4		**3000W**			
Total Monthly Estimate					

2. Check your electrical bill from last month to see how close your estimate is to the actual bill.

STUDENT LEARNING ACTIVITY

CALCULATING OPERATING COSTS OF EXIT SIGNS

Student Name: _____

DID YOU KNOW

If it seems like there are exit signs everywhere, it is because there are an estimated 3 million exit signs in Canada alone, consuming between 1 or 2 billion kWh of energy each year. Most signs use incandescent bulbs, which use large amounts of energy and require more maintenance. The typical exit sign uses two 20-watt bulbs. The signs are lit 24 hours a day and 365 days a year. Let's do the math for a single sign:

- Energy consumption (kWh) = [40W x 24h x 365d] / 1000 = 350 kWh/year
- Energy cost per year = 350kWh x $0.0212 = $19.25/fixture per year

1. How many EXIT signs are there in your school? _____ (A)
2. Calculate the energy cost: Total Annual: _____ (A x $19.25)
3. How might the costs of operating EXIT signs in your school be reduced without negatively impacting safety?

_____

_____

_____

_____

_____

_____

STUDENT LEARNING ACTIVITY

CHALLENGE ACTIVITY – READING YOUR ELECTRICAL METER AND DETERMINING DAILY USAGE AND COSTS

Student Name: _____

An electrical meter measures the amount of electricity used in your home. You can measure electricity consumption for any time period – a day, a week, a month. Ask your parents to help you do it – it's easy!

Meter Facts

- Meters record kilowatt hours (kWh) of electricity.
- Usually a meter has four or five dials with hands that turn in opposite directions.
- Most meters are read from left to right.
- When the hands are between two numbers, record the lower number (remember that "0" represents zero AND the number ten, so when the hand is between 0 and 9, the number would be 9).

Steps To Follow:

A. Determine the meter reading today

_____

B. Determine the meter reading tomorrow

_____

C. Calculate the amount of kWh used in the 24 hour period (B – A = C)

_____ kWh (C)

D. Determine the daily cost (C x $0.05 = daily cost)

$ _____

E. Determine the monthly cost (D x 30 days = monthly electrical cost)

$ _____

F. Determine the annual costs (D x 365 days = annual electrical cost)

$ _____

STUDENT LEARNING ACTIVITY

DOMESTIC WATER USAGE

Student Name: _____

DID YOU KNOW

Setting your water heater to the correct temperature can save you money, reduce greenhouse gas emissions and prolong the life of your hot water tank!

Activity:

The temperature gauge on your hot water tank may be misleading. Get an accurate reading by following these easy steps:

1. Run hot water from the kitchen faucet for one minute
2. Measure the water temperature with a reliable thermometer
3. Repeat the temperature test at the bathroom faucet
4. If your average temperature readings for an electric hot water tank are above 55-60°C or 50-55°C for a natural gas water heater, have an adult reduce the temperature settings and repeat your study daily until the temperature is within the above range.

Quiz:

1. What water device uses the most water in your house?

   _____

2. List three ways that you can reduce water consumption in your home.

   _____

   _____

   _____

   _____

   _____

3. List two reasons why we should be concerned about reducing our water usage at home.

   _____

   _____

   _____

   _____

4. How long can the human body exist without water? One day? Three days? One week? Three weeks? Three months?

   _____

STUDENT LEARNING ACTIVITY

WATER EFFICIENCY – WHAT DIFFERENCE DOES AGE MAKE?

Student Name: _____

Purpose of this activity: offers students the opportunity to determine if there are differences in water consumption patterns relative to the age of the user.

Process:

1. Make your own predictions about the attached survey
2. Conduct your survey with at least three persons from each age category
3. Graph your data for baths and showers taken on a bar chart
4. Compare your predictions to your survey data

Age Groups:

1. Under age 6
2. Age 6-12
3. Age 13-19
4. Age 20-39
5. Age 40-64
6. Over age 65

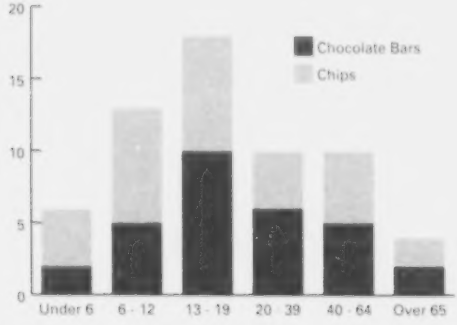
Student Predictions:
Considering the above age groups, which age group do you predict:

a. Will use the most water in a week? _____

b. Will take the most showers in a week? _____

c. Generally prefer tub baths over showers? _____

Representing the survey data:
Sample Graph



(Adapted from: Unit IV Lesson 9, Fort Whyte Centre, Slow The Flow Water Education Programme Curriculum Enrichment and Resource Package – Middle Years)

STUDENT LEARNING ACTIVITY (CONT'D)

Household Water Consumption Questionnaire

Please take a few minutes to review this form and explain to all the people living in your house that this survey is part of a classroom assignment to determine water usage patterns in homes. Please assure everyone that we are only collecting water consumption information related to age of the people in the home.

Please ask everyone in your home to do some accurate record keeping over the next week. Ask each person to record the number of baths and the number of showers they had in the one week period. Summarize the information into the following chart.

The information collected should be for a one week period:

Beginning on: _____

Ending on: _____

Summary of Water Consumption During the Period:

_____

Thank-you for your assistance in helping me to complete this assignment!

Student Name: _____

Age Group	Number of Persons in the Age Group	Total Number of Showers Taken	Total Number of Baths Taken
Under Age 6			
Ages 6 - 12			
Ages 13 - 19			
Ages 20 - 39			
Ages 40 - 64			
Over 65			
Totals			

(Adapted from: Unit IV Lesson 9, Fort Whyte Centre, Slow The Flow Water Education Programme Curriculum Enrichment and Resource Package – Middle Years)

STUDENT LEARNING ACTIVITY

GREENHOUSE GAS EMISSIONS & CLIMATE CHANGE

Student Name: _____

1. What is the "greenhouse effect"? Explain your answer by providing information about the causes and the changes that may result.

   _____

   _____

   _____

   _____

2. What are three anticipated consequences of climate change in Manitoba?

   _____

   _____

   _____

3. Name three major sources of greenhouse gas emissions in Canada. Describe how these emissions are commonly created.

   _____

   _____

   _____

4. List five ways in which ***you*** could help in reducing greenhouse gases:

   a. _____

   b. _____

   c. _____

   d. _____

   e. _____

5. Select the word or phrase to best complete the following statements:

daylight hours	**the greenhouse effect**	**dust particles**
solar heating	**average weather**	**photosynthesis**
gases	**molecules**	**amount of rainfall**

   a. Climate change is a change in the _____ that a given region experiences.

   b. A natural system known as _____ regulates the temperature of the earth.

   c. The atmosphere is a complex mixture of _____ that trap the sun's heat near the earth's surface.

STUDENT LEARNING ACTIVITY

THE THREE R'S

Student Name: _____

1. From the list of ***The Three R's***, which one is the most important to you?

   _____

   Explain why.

   _____

   _____

   _____

   _____

   _____

   _____

2. Think of three items that you have that you can reuse rather than dispose of.

   a. _____

   b. _____

   c. _____

3. What can you "refuse" that will benefit the environment?

   _____

   _____

   _____

   _____

   _____

   _____

4. Chose the best of the following words to complete these sentences:

   repair **recycle** **re-use** **renew**

   a. You put everyday items like bottles and newspapers into a bin to _____ them.

   b. Don't throw out your empty plastic water or drink bottle! You can _____ it instead and fill it with water over and over again.

   c. Rather than buy a new bicycle, you might be able to _____ your old one.

   d. When the mine was closed, new trees were planted as part of an effort to _____ the site.

VOCABULARY BUILDERS

Vocabulary Builder

Student Name: _____

Date: _____

MATCHING

Match the definition in column 1 to the word(s) in column 2.

1	2
a. solar, thermal, and wind energy are forms of this	1. reduce
b. oil, coal, and natural gas are forms of this	2. nonrenewable energy
c. photovoltaic technology	3. renewable energy
d. the first and most important of the 3 R's	4. solar energy
e. the gradual change in climate that's attributable to heat-trapping gases in the atmosphere	5. climate change
f. Canada's most important greenhouse gas emission	6. thermal energy
g. turning the raw materials of one product into a new product	7. recycling
	8. carbon dioxide

POWER SMART CRYPTOGRAM

Determine the pattern and decode this Power Smart message

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
22				12									23											8	

21	22	17	12		12	23	12	19	16	8		22	23	1											

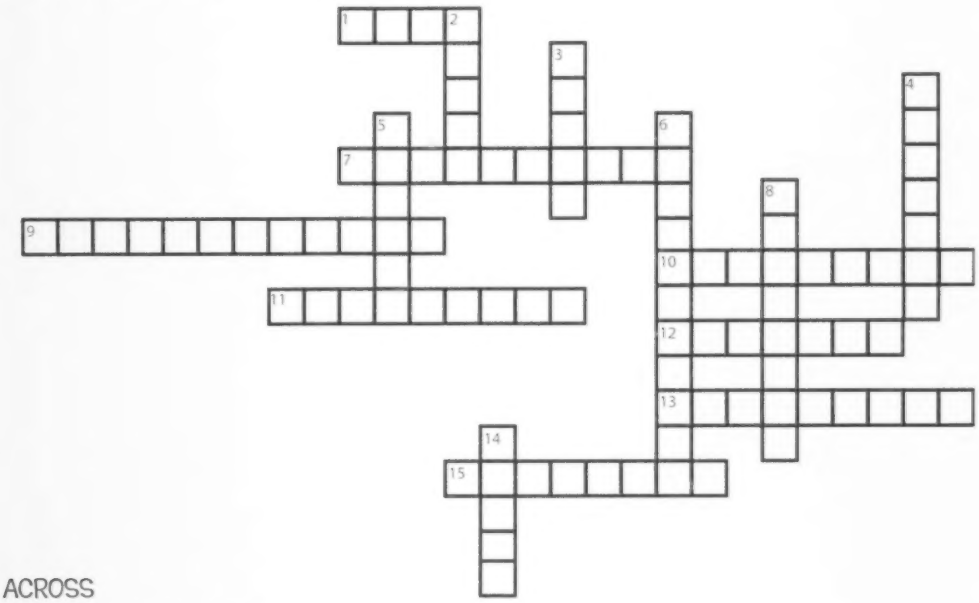
21	22	17	12		9	11	23	12	8																

Vocabulary Builder

Student Name: _____

Date: _____

ENERGY KNOWLEDGE CROSSWORD



ACROSS

1. There are many hydro _____ on the Winnipeg River.
7. An alternative to electric or gas heating is a _____ heat pump.
9. A unit of measurement for the consumption of energy.
10. Wind and solar energy are examples of energy that is _____.
11. Energy that is converted from one form to another.
12. Kelsey Generating _____.
13. Lights that use less energy than others are energy _____.
15. A unit of conserved energy that can now be used for something else is called a _____.

DOWN

2. Power _____.
3. Manitoba's electrical utility is Manitoba _____.
4. Composting is a form of this R.
5. The first of the three Rs to consider.
6. A compact _____ is an example of an energy efficient light fixture.
8. Hydro- _____ generation.
14. Using a plastic shopping bag to pack your lunch is an example of this R.

Vocabulary Builder

Student Name: _____

Date: _____

WORD FIND

A F S K E L B A W E N E R P E W G
S L G D U J R E D U C E E F V F R
B E D I X O I D N O B R A C A K E
M T U A K H G R M T V F Y U L E T
E V R E S N O C R E C Q O D U T A
G P M C D R U A T Y T E E K A Q W
A L O Y N E M J H C X H L J T M G
W R T G L S D O O L F P A E E F T
A S T R R U H Q A C J C V N L S N
T M A E W E R Y H W D A S I E I E
T N W N V R F B D J S O L A R S I
V O O E D M D G O R C S B O K R C
P B L N R A I M N C O A T I A E I
C L I S M Z T P D U C J B S I D F
T W K L A I T N E T O P H V O U F
A U R M L A M R E H T O E G K C E
D E N S E L E C T R I C A L H E G

- ☐ carbon dioxide
- ☐ conserve
- ☐ costs
- ☐ dam
- ☐ efficient
- ☐ electrical
- ☐ energy
- ☐ evaluate
- ☐ flood
- ☐ geothermal
- ☐ hydro
- ☐ kilowatt
- ☐ methane
- ☐ Power Smart
- ☐ reduce
- ☐ renewable
- ☐ reuse
- ☐ save
- ☐ solar
- ☐ water
- ☐ wind

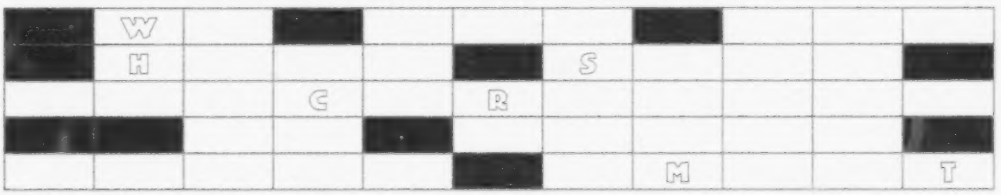
Vocabulary Builder

Student Name: _____

Date: _____

POWER SMART SCRAMBLED COLUMNS

Decode this Power Smart message.



Place one letter from each column into a box in the column of boxes directly above. The first few letters of this message have been done for you!

		E				S		I	L	
	~~H~~	E	Y	T		I	C	V	R	
	~~W~~	B	~~S~~	C	A	~~S~~	I	A	T	L
P	O	E	L	R	~~R~~	N	~~M~~	A	E	~~T~~
E	L	W	E	P	B	E	A	N	G	Y

POWER SMART SCRAMBLED WORDS

Unscramble these words and decode the Power Smart message.

GEYREN _ _ ◯ _ _ _

ROMLHAEGET _ _ ◯ _ ◯ _ _ _ _ _

TEOTINPAL _ _ _ _ _ ◯ ◯ _ _

MADS _ _ _ ◯

DYHRO ◯ _ _ ◯ _

TFEUSECROLN _ ◯ ◯ _ _ _ _ _ _ _ _

TAANEWGT _ _ ◯ _ _ _ _ _

CETFEIFIN _ ◯ ◯ _ _ _ _ _ _

SECRET MESSAGE: _ _ _ _ _ _ _

Vocabulary Builder

Student Name: _____

Date: _____

WORD FILL

1. Match each of the following terms with the appropriate sentence:

fossil fuels	**climate change**
greenhouse gas	**energy efficiency**

   a. _____ is a change in the "average weather" that a given region experiences

   b. Human activities contribute to climate change primarily through the _____ emissions produced by burning fossil fuels.

   c. Oil, coal, and natural gas are common _____ used in our daily lives.

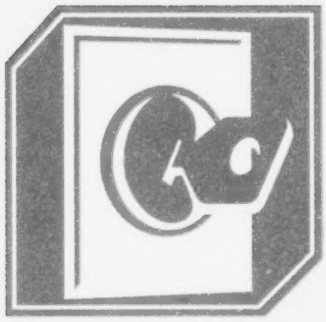
   d. _____ means using energy in the most economical way possible and keeping its use to a minimum.

2. Use these words in the energy story below

wisely	**waste**
energy efficiency	**appetites**
environment	**sweater**
lights	**difference**
thermostat	**showers**

   As our population continues to grow, so must our concern for our _____. Many families _____ electricity every day. Some _____ tips to know are: shorter _____ save energy, small appliances have little _____ _____, lowering the _____ saves energy, wearing a _____ will help, and turning out the _____ when you leave the room.

   We all need to use energy and our resources _____. The future is in our hands; we can make a world of _____ if each of us does our part.



ANSWER KEYS FOR VOCABULARY BUILDERS

ANSWER KEY

Vocabulary Builder

MATCHING

Match the definition in column 1 to the word(s) in column 2.

1	2
a. solar, thermal, and wind energy are forms of this	1. reduce
b. oil, coal, and natural gas are forms of this	2. nonrenewable energy
c. photovoltaic technology	3. renewable energy
d. the first and most important of the 3 R's	4. solar energy
e. the gradual change in climate that's attributable to heat-trapping gases in the atmosphere	5. climate change
f. Canada's most important greenhouse gas emission	6. thermal energy
g. turning the raw materials of one product into a new product	7. recycling
	8. carbon dioxide

POWER SMART CRYPTOGRAM

Determine the pattern and decode this Power Smart message

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
22			1	12								9	23				19	21			17			8	

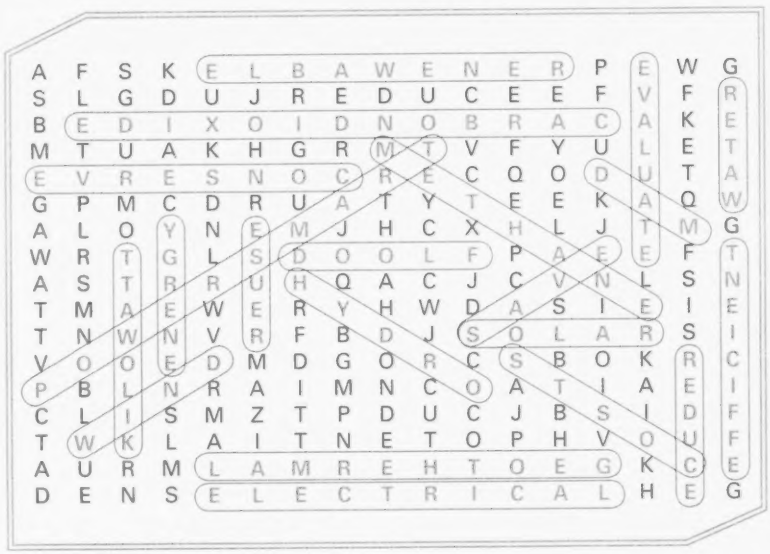
S	A	V	E		E	N	E	R	G	Y		A	N	D
21	22	17	12		12	23	12	19	16	8		22	23	1
S	A	V	E		M	O	N	E	Y					
21	22	17	12		9	11	23	12	8					

ANSWER KEY

Vocabulary Builder

ENERGY KNOWLEDGE CROSSWORD

WORD FIND



- ☐ carbon dioxide
- ☐ conserve
- ☐ costs
- ☐ dam
- ☐ efficient
- ☐ electrical
- ☐ energy
- ☐ evaluate
- ☐ flood
- ☐ geothermal
- ☐ hydro
- ☐ kilowatt
- ☐ methane
- ☐ Power Smart
- ☐ reduce
- ☐ renewable
- ☐ reuse
- ☐ save
- ☐ solar
- ☐ water
- ☐ wind

ANSWER KEY

Vocabulary Builder

POWER SMART SCRAMBLED COLUMNS

POWER SMART SCRAMBLED WORDS

GEYREN _ _ _ _ _ _

ROMLHAEGET _ _ _ _ _ _ _ _ _ _

TEOTINPAL _ _ _ _ _ _ _ _ _

MADS _ _ _ _

DYHRO _ _ _ _ _

TFEUSECROLN _ _ _ _ _ _ _ _ _ _ _

TAANEWGT _ _ _ _ _ _ _

CETFEIFIN _ _ _ _ _ _ _ _ _

SECRET MESSAGE: _ _ _ _ _ _ _ _ _ _

ANSWER KEY

Vocabulary Builder

WORD FILL

1. Match each of the following terms with the appropriate sentence:

fossil fuels	**climate change**
greenhouse gas	**energy efficiency**

   a. **Climate change** is a change in the "average weather" that a given region experiences

   b. Human activities contribute to climate change primarily through the **green house gas** emissions produced by burning fossil fuels.

   c. Oil, coal, and natural gas are common **fossil fuels** used in our daily lives.

   d. **Energy efficiency** means using energy in the most economical way possible and keeping its use to a minimum.

2. Use these words in the energy story below

wisely	**waste**
energy efficiency	**appetites**
environment	**sweater**
lights	**difference**
thermostat	**showers**

As our population continues to grow, so must our concern for our **environment**, Many families **waste** electricity every day. Some **energy efficiency** tips to know are: shorter **showers** save power, small appliances have little **appetites**, lowering the **thermostat** saves energy, wearing a **sweater** will help, and turning out the **lights** when you leave the room.

We all need to use energy and our resources **wisely**. The future is in our hands; we can make a world of **difference** if we do our part.

GLOSSARY

Carbon dioxide is the greenhouse gas with the largest amount of emissions. This gas is naturally released as we breathe and is good in regular amounts since plants need it to conduct photosynthesis.

Droughts – A long period of abnormally low rainfall, especially one that adversely affects growing or living conditions. This could result from the greenhouse effect.

Energy – Energy is the capacity to do work or to make things move.

Geothermal Energy – A single efficient system can be used for both heating and cooling, eliminating the need for separate furnace and air-conditioning systems. It can also heat water at no additional cost. An earth energy system uses a series of buried pipes to transfer the heat from the ground into a building during the winter, converting it into warm air and distributing it through ducts. In summer, the system is reversed to transfer heat out of the building, where it uses the cooler ground as a heat sink.

Greenhouse Effect – The greenhouse effect is Gases in our atmosphere – water vapor, carbon dioxide, methane, and nitrous oxide – acting like a greenhouse to keep the sun's heat in and help make our planet livable. This effect has been drastically increased in recent years causing rapid increase in the Earth's temperature that may be harmful in the future.

Heat wave – A period of unusually hot weather. This could result from the greenhouse effect.

Hydro – Moving or falling water, which is an immense source of potential energy.

Megawatt – A unit of energy that can be used for another purpose.

Methane – A gas partially responsible for Canada's greenhouse emissions. The main sources of methane emissions are from oil and gas production, animal digestion and manure, municipal landfills, and coal mining.

Nitrous Oxide – A greenhouse gas with its primary sources being transportation and fertilizer use.

Power Smart and using efficient technologies and avoiding the use of energy practices that are bad for the environment.

Recycle – Recycling is turning the raw materials of one product into a new product.

Reduce – Reduce is the first of the three R's. To reduce is to decrease all unnecessary waste in every way possible.

Renewable Energy comes from sources that are continuously or easily renewable. Examples include solar power which comes from the sun, wind power, geothermal power, and hydroelectric power.

Reuse – Reusing a product is using a product more than once for its original purpose or for a new purpose rather than throwing it away.

ONLINE RESOURCES

Climate Change

- www.climateark.org
- www.climatechangeconnection.org

Energy & Electricity

- http://www.hydro.mb.ca/saving_with_ps/psmart_home.shtml
- www.hydro.mb.ca/in_the_community/learning_zone/index.shtml
- www.rebuild.org/attachments/SolutionCenter/SchoolEnergyGuidebook.pdf
- www.rebuild.org/sectors/SectorPages/EnergyEducation.asp
- www.lightbulbsdirect.com/lbe_energyaudit.html?OVRAW=Energy%20Audits&OVKEY=energy%20audit&OVMTC=standard
- www.bchydro.com/powersmart
- www.ase.org/section/_audience/educators/
- www.wattsnew.com/wattsnew3/bigbutton/kids_wattsbuttons333.html
- www.energyquest.ca.gov/index.html
- www.eere.energy.gov/consumerinfo/energy_savers/
- www.window.state.tx.us/tspr/energy/
- www.eere.energy.gov/kids/
- www.oee.nrcan.gc.ca/calendarclub/

The Three R's

- www.virtualrecycling.com
- www.mpsc.ca

Water Efficiency

- www.gov.mb.ca/conservation/pollutionprevention/wateruse/

Manitoba Hydro

R.B. Brennan, FCA
President and
Chief Executive Officer

March 2005

Dear Educators:

Manitoba Hydro is pleased to introduce two new exciting resources for Manitoba educators. The Education Co-ordinators at Manitoba Hydro have developed a Virtual Tour of the Manitoba Electrical Museum, as well as a handbook of Power Smart Energy Efficiency Learning Resources that has become an integral part of the Interdisciplinary Middle Years Multi Media unit entitled *Inventors, Innovations, and Discoveries*.

Over the past year, Manitoba Hydro and consultants from Manitoba Education, Citizenship and Youth have been working together to provide a comprehensive package of support materials. I am pleased to provide a Virtual Tour of the Manitoba Electrical Museum CD and a Handbook of Power Smart Energy Efficiency Learning Resources for use in your school.

Last year, about 500 visitors explored the museum to learn about our province's electrical history and how electricity is used today. In order to enable many of our remote schools in the province to see the museum, we have produced a CD virtual tour that showcases the marvels of electrical history with six main theme areas, portraying the story of electricity in Manitoba from the 1870s to the present, as well as a view into the future. Internet links to information found on Manitoba Hydro's website, as well as supplementary materials for teachers, are included in the package. It is our pleasure to increase access to our facility by allowing teachers and students the opportunity to visit the museum from their classrooms.

Manitoba Hydro's Power Smart initiative continues to encourage energy efficiency with consumers and businesses in Manitoba through delivery of information and programs. The Handbook of Power Smart Energy Efficiency Learning Resources has been designed to provide teachers with an additional tool to educate students on Power Smart and sustainable behaviours that will contribute to the preservation of our delicate environment. Five main themes are addressed including: Energy, Electricity, Water, Climate Change, and The Three Rs (Reduce, Reuse, Recycle). The booklet also contains teacher resource materials and student learning activities.

For additional education and safety resources, contact Manitoba Hydro's Education Coordinator, Jenett Richter, by calling our Manitoba Electrical Museum at (204) 477-7901.

Yours truly,

Bob Brennan

RBB/emm
Enc.

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